



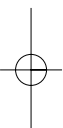
Centrifugal **Oil Cleaners**

maintaining the **life-blood** for industry

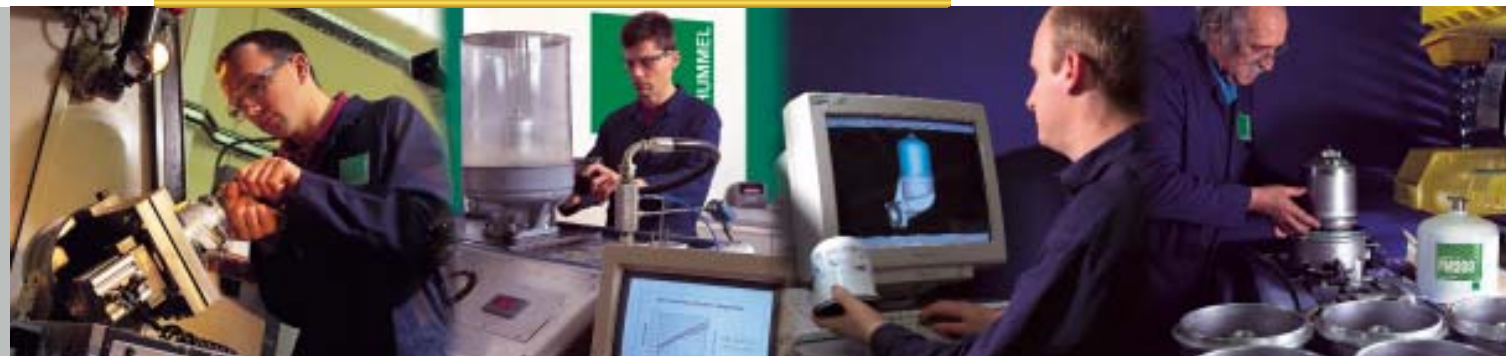


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Introduction



Since the foundation of the company in 1941, the name MANN+HUMMEL has been synonymous with superior quality filtration products. Even at that time, the development, production and sale of filters and filter elements for the automotive industry was the company's main area of activity. This is still true today because high product quality and the innovative skills of MANN+HUMMEL employees have always been the main features of our company.

Now, they form the basis for the international success of the MANN+HUMMEL Group. A large number of newly developed products and technologies have helped us to keep pace with rapid developments in automotive manufacturing and increased customer demands.

MANN+HUMMEL has not only speeded up the pace of filter development, but has also influenced it at times, aided by state-of-the-art research stations combined with optimally equipped laboratories and test facilities and, last but not least, the continuous exchange of ideas with our customers.

The rise from one of the industries leading filter manufacturers to becoming a recognised systems supplier for the automotive industry was ultimately the result of successful work in the past.

Working in conjunction with our OEM customers, MANN+HUMMEL centrifuges are incorporated into engine designs as original equipment or may be installed by the end user to existing engines.

Models are available for diesel engines, transmissions and industrial applications within the marine, truck, transit, military, locomotive, power generation, automotive, mining, agricultural and construction markets.





Oil is the life-blood of the engine and clean oil is essential if an engine is to operate efficiently throughout its working life. Many of the key objectives in modern engine design are directly related to the condition of the lubricating oil.

In response to changes in economic and environmental circumstances, conservation of engine lubricating oil is becoming increasingly important. Savings are being realised through reductions in oil consumption and the implementation of extended oil drain periods. As a result, modern oils must work harder, resist degradation for longer periods and must retain greater volumes of total insolubles. Therefore changes in both oil chemistry and filtration technology are required to meet these needs.

The primary effect of new diesel engine design features, such as exhaust gas re-circulation (E.G.R.), is to reduce harmful exhaust emissions. The secondary effect of this is to increase the amount of contamination, especially soot, finding its way into the lubricating oil. Engine designers regard soot reduction as one of their key objectives to meet future targets for reduced exhaust emissions, extended service intervals and increased engine durability. To comply with these future

requirements improved methods of maintaining lube oil cleanliness are of great importance.

Equally, end users of engines often find the environment and work duty in which they operate have an impact on lube oil condition.

The effects of increased levels of oil contamination:

- Increased oil thickening
- Decreased oil life
- Shortened service intervals
- Increased component wear

- Decreased engine life to overhaul
- Increased fuel consumption due to component wear
- Increased down-time due to component failure
- Increased cost of ownership

MANN+HUMMEL centrifugal sedimentation technology can provide for OEM fit and retrofit oil conditioning systems, which have the ability to remove large amounts of harmful fine soot from lube oil and to store it for eco-friendly disposal.

How By-pass Centrifugal Oil Cleaners work

Full flow filters are designed to process all of the oil used to lubricate the moving parts of an engine. However, the need to maintain a high flow and limit pressure drop across the filtration media restricts the ability of full flow filters to remove fine contaminant particles. Full flow filters therefore essentially act as a screen or barrier against the progress of large abrasive particles through the lubrication oil circuit, which may cause catastrophic failure.

The MANN+HUMMEL centrifugal oil cleaner operates in by-pass and processes approximately 10% of lube oil before returning it to the engine's sump.

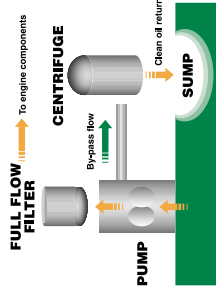


Oil is pumped into the centrifuge by the engine's oil pump at pressure and directed into a hollow spindle where it exits via a cross-drilling into the centrifuge rotor. The rotor becomes full of pressurised oil that is then allowed to exit through two tangentially opposed nozzles in the rotor base.

This causes rotation of the free spinning rotor assembly thus generating centrifugal

force within the rotor. As contaminant particles enter the rotor they are subjected to a centrifugal force causing them to migrate radially outwards to the inner surface of the rotor wall where, over time, they compact to form a dense cake.

MANN+HUMMEL Oil Conditioning Systems offer both cleanable and disposable rotor designs.



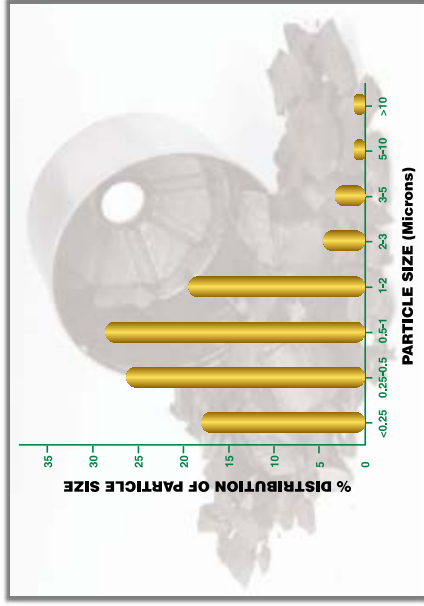
maintaining the **life-blood** for industry

Main Benefits



- MANN+HUMMEL by-pass centrifugal oil cleaners offer you all these benefits:**
- Improved lube oil cleanliness
 - Extended oil life
 - Extended service intervals
 - Reduced component wear
 - Increased engine life
 - Reduced down-time
 - Lower maintenance costs
 - Reduced cost of ownership
 - Easier maintenance
 - Totally cleanable by-pass filtration

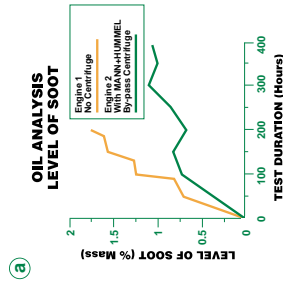
Typical Particle Size Distribution of Centrifuge Contaminant



Centrifugal force is capable of removing a wide range of particles extending into the sub-micron range. Analysis of the dirt collected by a MANN+HUMMEL centrifuge reveals an ability to remove particles of less than one micron in size including engine clogging soot: oil films protecting critical engine components are equally as small. If not removed contaminant particles in this size range cause component wear and a consequent reduction of engine durability.

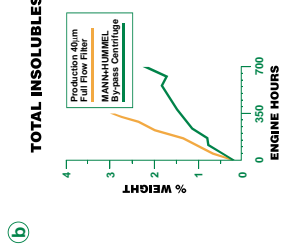


Comparative engine test results to demonstrate the advantages of a centrifugal by-pass oil cleaner



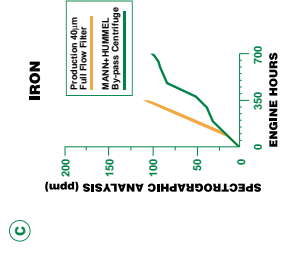
(a) Engine Test Result 1
2.5 litre direct injection diesel engine with E.G.R.

The centrifuge has dramatically reduced the rate of increase of combustion soot levels within the lubricating oil to around 50%. Increased soot loading accelerates oil thickening and contributes to engine component wear. Controlling the levels extends service intervals and increases engine durability.



(b) Engine Test Result 2
8 litre diesel engine

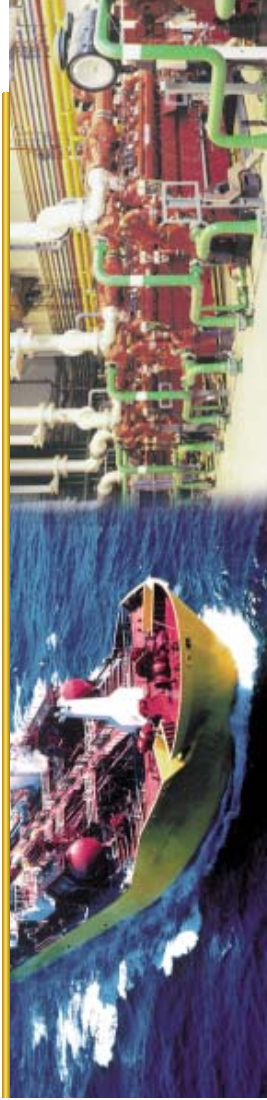
As the lube oil becomes loaded with contaminant the total insolubles level rises and it becomes unserviceable at a predetermined insolubles level. In the test engine the maximum total insolubles level was 3%. The test result shows a by-pass centrifuge controlled total insolubles at a level below the engine manufacturer's condemnation limit at more than double the specified oil drain interval.



(c) Engine Test Result 3
8 litre diesel engine

The rate of iron accumulation in the oil of the engine with a by-pass centrifuge is substantially lower than an engine operating with just a standard full flow filter, thus reducing the rate at which engine components wear out.

Marine and Power Generation



Guascor Cogeneration Plant

How Important is Your Engine to You?

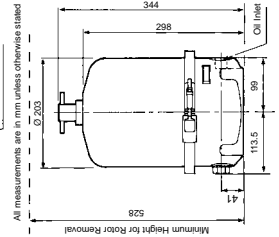
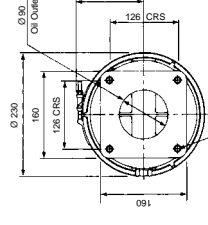
For over 50 years the MANN+HUMMEL centrifuge has proved to be the key factor in reducing component wear whilst increasing the oil and engine life cycle. Through close collaboration with over 40 original equipment manufacturers (OEMs) in as many years, MANN+HUMMEL has gained an in-depth understanding of customer requirements. This wealth of experience has helped us to further develop a product that is not only easy to install on existing applications, but also provides a cleanable, low maintenance and environmentally friendly solution throughout the life span of the engines.

In close collaboration with MANN+HUMMEL, Detroit Diesel/MTU have significantly extended oil drain intervals on their Series 4000 engine.

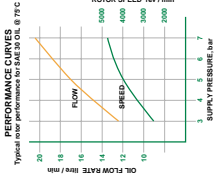
We are world leaders in the field of by-pass oil conditioning systems and have over the years established a large following within the marine and power generation market.

Our success lies in:

- Reducing critical component wear of bearings, pistons, rings etc
- Lowering the cost of ownership
- Maintaining oil cleanliness for longer periods of time
- Controlling increased oil contaminant loading in medium and heavy fuel applications effectively
- Cleanable, environmentally friendly waste disposal



All measurements are in mm unless otherwise stated



Typical Engine Range 500 - 10,000 hp (370 - 7,500 kW)

FM200

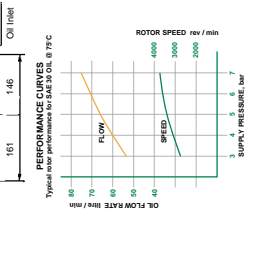
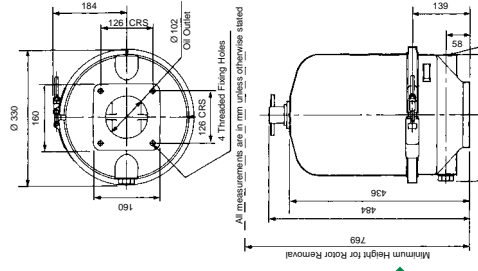
- For this centrifuge the following items are available:
 - Fixing bracket 7009A
 - Remote mounting base with air assisted drainage 09111A
 - Rotor disassembly tool 6906A
 - Standtube extraction tool 6909A
- The net weight of the FM200 is 9.5 kg
- This model is only available with a cleanable rotor
- Oil inlet threads and cut off valve (C.O.V.) ratings can be tailored to suit customers requirements

FM600

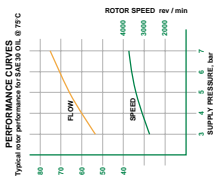
- For this centrifuge the following items are available:
 - Fixing bracket 7010A
 - Remote mounting base with air assisted drainage 09111A
 - Rotor disassembly tool 6905A
- The net weight of the FM600 is 25 kg
- This model is only available with a cleanable rotor
- Oil inlet threads and cut off valve (C.O.V.) ratings can be tailored to suit customers requirements

Criteria	FM200	FM600
Lubrication system capacity	40 - 170 l	200 - 1,500 l
Rotor dirt capacity	2 l	6 l
Rotor oil capacity	2.3 l	6.5 l
Internal oil feed diameter (min.)	12 mm	19 mm
Internal oil drain diameter (min.)	50 mm	76 mm

The centrifuge models detailed above are only part of the range that can be applied in this particular market. Please refer to page 14 for centrifuge selection procedures for a given engine specification.



All measurements are in mm unless otherwise stated

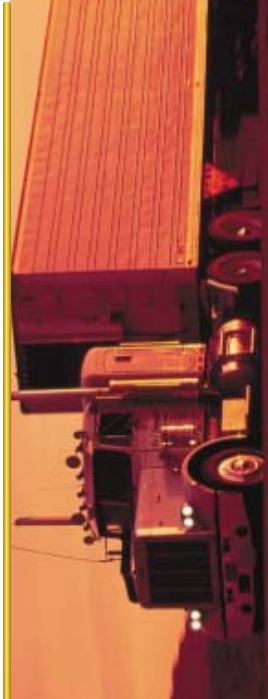


OEM Customers

- Allens
- Anglo Belgian Co.
- Caterpillar
- Cummins Wartsila
- Detroit Diesel Corporation
- Deutz
- Guascor
- Hyundai
- MaK
- MAN B&W
- Moteurs Baudouin
- MTU
- Perkins
- Scania
- SEMT Pielstick
- Ssangyong
- Ulstein Bergen
- Wartsila NSD

Lifeboat picture reproduced by kind permission of RNLI who use MANN+HUMMEL filters on their Caterpillar engines.

Truck and Bus



MANN+HUMMEL are Focused on Servicing Customers' Needs

Continuous improvements to centrifuge performance over the years has enabled MANN+HUMMEL to transform OEM and end user objectives into reality. As a result, truck and bus applications incorporating the MANN+HUMMEL centrifuge now benefit from:

- Extended oil drain intervals well beyond previous expectations
- Lower cost of ownership through a reduction in component wear
- Environmentally friendly waste disposal

Due to the unique way in which the centrifuge removes even the smallest particles of contaminant, OEM

manufacturers worldwide regard this MANN+HUMMEL product as an effective and economical means of maintaining oil cleanliness.

In close collaboration with MANN+HUMMEL, DAF have managed to extend their oil drain interval on the 95XF engine from 50,000 to 100,000 km (30,000 - 60,000 miles).

Our success does not solely lie with the manufacturers. The ability to mount the centrifuge remotely from the engine, if required, means that both individual truck or bus owners and the larger fleet companies have been able to retrofit our product with ease and experience the benefits of centrifugal oil filtration.

Typical Engine Range 200 - 600 hp (180 - 450 kW)

FM060-LCB

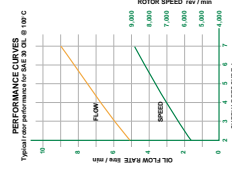
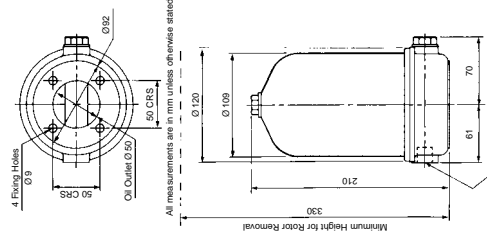
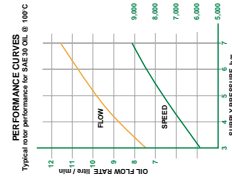
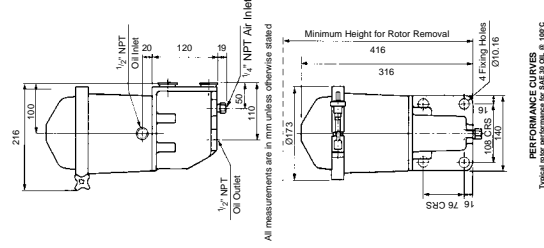
- The net weight of the FM060-LCB is 5.5 kg
- This model is only available with a cleanable rotor
- Oil inlet threads and cut off valve (C.O.V.) ratings can be tailored to suit customers requirements
- For further information on principles of operation and installation please request separate FM060-LCB data sheet

FM050

- Available with or without cut off valve (C.O.V.)
- The net weight of the FM050 is 1.8 kg
- This model is only available with a disposable rotor

Criteria	FM060-LCB	FM050
Lubrication system capacity	15 - 90 l	15 - 90 l
Rotor dirt capacity	0.6 l	0.5 l
Rotor oil capacity	0.75 l	0.6 l
Internal oil feed diameter (mm.)	9.5 mm	9.5 mm
Internal oil drain diameter (mm.)	9.5 mm	38 mm

The centrifuge models detailed above are only part of the range that can be applied in this particular market. Please refer to page 14 for centrifuge selection procedures for a given engine specification.



OEM Customers and Fleets

- Caterpillar
- Chicago Transit Authority
- Compton Commercials
- Consolidated Freightways
- DAF
- Ford Otosan
- Mack Trucks
- Navistar
- Renault V.I.
- Scania
- Sealand Services
- U.S. Postal Service

Mining, Construction and Agriculture



Off-road applications in the mining, construction and agricultural industries are commonly subjected to extreme operational conditions and

environments which greatly affect an engine's operational life.

Many end users operating in hostile environments choose

to reduce their oil drain interval below that recommended.

The MANN+HUMMEL centrifuge with its ability to keep the engine lube oil clean, allows end users to extend oil drain intervals, even in hostile environments.

Further benefits achieved:

- Lower cost of ownership through reduced critical component wear
- Reduced service costs
- Reduced down-time
- Maximised engine productivity
- Highly competitive and efficient means of maintaining oil cleanliness
- Increased dirt holding capacity in comparison to standard by-pass filtration systems whilst maintaining original flow characteristics at all times

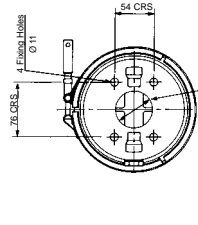
MANN+HUMMEL's centrifuge experience does not only extend to engine lube oil systems. MANN+HUMMEL, in partnership with AGCO have successfully applied a

centrifuge to the transmission of the Massey Ferguson 4200 tractor series achieving an extension of oil life to 1,000 hours.

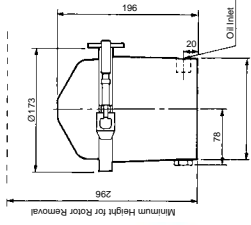
Centrifuges have also been applied on rock crushing equipment for cleaning heavily contaminated lubricating oil.

This results in considerable savings in down time and replacement component parts due to substantial reductions in component wear.

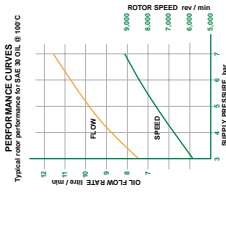
As conditions deteriorate, the centrifuge makes the difference.



All measurements are in mm unless otherwise stated



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Typical Engine Range 200 - 1,000 hp (150 - 750 kW)

FM025

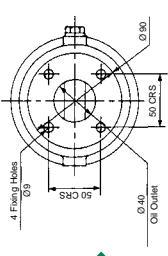
- Available with or without cut off valve (C.O.V.)
- This model is only available with a cleanable rotor
- The net weight of the FM025 is 1.4 kg

FM060

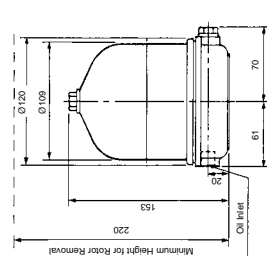
- Available with or without cut off valve (C.O.V.)
- This model is only available with a cleanable rotor
- Fixing bracket 7112A is available for use with this product
- The net weight of the FM060 is 3 kg

Criteria	FM025	FM060
Lubrication system capacity	5 - 15 l	15 - 90 l
Rotor dirt capacity	0.25 l	0.6 l
Rotor oil capacity	0.32 l	0.75 l
Internal oil feed diameter (mm)	6 mm	9.5 mm
Internal oil drain diameter (mm)	25 mm	38 mm

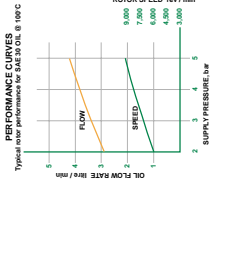
The centrifuge models detailed above are only part of the range that can be applied in this particular market. Please refer to page 14 for centrifuge selection procedures for a given engine specification.



All measurements are in mm unless otherwise stated



All measurements are in mm unless otherwise stated



OEM Customers

- AGCO (Massey Ferguson)
- Caterpillar
- Detroit Diesel Corporation

- Mack
- Navistar
- Scania

Automotive



MANN+HUMMEL

The ongoing struggle in the automotive industry for higher power to weight ratios, increased fuel economy and the necessity to comply with onerous emission regulations, are highlighting the need for the engine lubricating package to work harder than ever before. As engine manufacturers endeavour to produce 'sealed for life' engines, MANN+HUMMEL is keen to demonstrate that the centrifuge can play a vital role in achieving these goals.

In September 1998 Land Rover announced the release of their new 4x4 Discovery with an improved diesel engine design. With the centrifuge fitted as standard equipment, Land Rover have been able to increase their oil drain interval from 10,000 km to 20,000 km (6,000 miles to 12,000 miles).

MANN+HUMMEL has now developed a retrofit option that not only offers outstanding centrifugal performance, but which has also been designed for applications where space limitations are of concern.

By providing fleet companies with the necessary support required to retrofit the centrifuge, these companies will be able to boast lower cost of ownership whilst maintaining engine performance throughout the engine's lifecycle.

Continually pushing out the boundaries for service intervals.

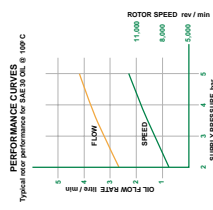
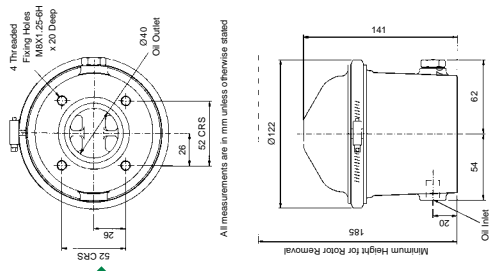
Typical Engine Range 50 - 150 hp (35 - 110 kW)

FM016

- This model is only available with disposable rotor
- The net weight of the FM016 is 1.2 kg

Criteria	FM016
Lubrication system capacity	3.5 - 12 l
Rotor oil capacity	0.16 l
Rotor oil capacity	0.21 l
Internal oil feed diameter (mm.)	6 mm
Internal oil drain diameter (mm.)	25 mm

The centrifuge models detailed above are only part of the range that can be applied in this particular market. Please refer to page 14 for centrifuge selection procedures for a given engine specification.



Oil Conditioning Systems
Press Release 7th August 1998
Oil Conditioning Systems, a business unit of MANN+HUMMEL have been working with Land Rover throughout the development cycle of their new 2.5 litre diesel engine.

"This is a major breakthrough for this sector of the diesel market", says David Purcell, Business Manager, Oil Conditioning Systems. "Our oil conditioning centrifuge combined with engine development has allowed Land Rover to set a new world standard for oil change intervals and engine performance".

Installation

Installation of a MANN+HUMMEL By-pass Centrifuge

A MANN+HUMMEL centrifuge can be designed onto an engine as original equipment or retrofitted to an existing engine by the end user. The by-pass centrifuge requires a supply of pressurised oil. In the majority of applications the oil supply is obtained at engine pressure via the lube oil pump. In cases where oil pressure is insufficient a slave pump can be installed. The centrifuge should be mounted at an angle of no more than 15° from the vertical. Temporary increases in tilt angle due to vehicle operation are not important. For OEM applications where tilt performance is essential MANN+HUMMEL will design the centrifuge arrangement to meet the required tilt specification.

The oil leaving the centrifuge needs to be able to fall back to the engine's oil reservoir under gravity. It is therefore important that the oil drain is free from restrictions and that the return is above the oil level within the reservoir.

When installing a by-pass centrifuge it is vital that engine components are not starved of the oil required for lubrication. During installation, checks should be made to ensure the oil system can support the extra flow taken in by-pass by the centrifuge. MANN+HUMMEL centrifuges can be prevented from taking oil when engine oil pressure falls below a pre-set value by fitting a cut off valve (C.O.V.). This prevents oil starvation under marginal lubrication conditions e.g. when the engine is idling. When the oil pressure rises above

the pre-set valve rating, the valve opens and the centrifuge operates normally.

The MANN+HUMMEL centrifuge will continue to operate over a wide range of oil temperatures and pressures. Please consult MANN+HUMMEL if any of the following conditions apply:

- The supply pressure exceeds 7 bar (special provisions can be provided for pressures above this level)
- The supply pressure is below 3 bar
- The oil volume used by the centrifuge exceeds 10% of the pump output
- The operating oil temperature falls below 50°C

To determine the correct centrifuge for an application it is important to review the total oil sump volume and the system lube oil flow rate. Performance curves for each centrifuge model are available within the different market sectors of the handbook.

The objective is to achieve the maximum number of sump passes per hour without exceeding the excess flow capacity of the engine pump. MANN+HUMMEL and its worldwide retrofit distribution network can provide assistance in determining the correct model for a specific application.

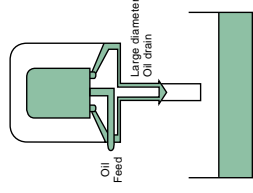
For retrofit applications where the direct engine mounting of the centrifuge is difficult MANN+HUMMEL offer remotely mounted designs (such as FM060, FM200 and FM600) which use air pressure to assist the clean oil to return to the reservoir. This option is applicable only for applications where a supply of compressed air is available.

For further information, please contact MANN+HUMMEL or your local distributor.

Installation

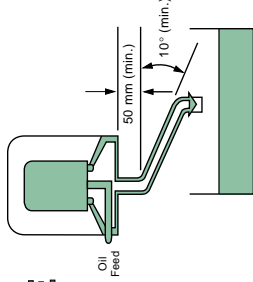
Fitting a MANN+HUMMEL Centrifuge

“A centrifuge is not a normal filter, it needs a larger oil return pipe”.



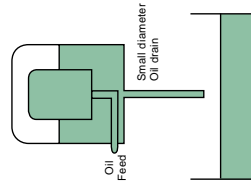
ACCEPTABLE

Large diameter oil return pipe means the oil will drain and the rotor will be free to turn



NOT ACCEPTABLE

Small diameter oil return pipe will prevent oil from draining from the centrifuge and will stop it working



Note: Some models are available with air assisted drains to allow them to be installed without the need for a large diameter oil return pipe.

FM016

Type	Part No.	Oil Inlet Thread	C.O.V. Rating, bar	Threaded Fixing Holes
016-BC	01281A	1/4" B.S.P.	1.3	M 8 x 1.25

FM025

Type	Part No.	Oil Inlet Thread	C.O.V. Rating, bar
025-3	01116A	1/4" B.S.P.	-
025-4	01117A	1/4" B.S.P.	1.3

FM050

Type	Part No.	Oil Inlet Thread	C.O.V. Rating, bar
050-7	01102A	3/8" B.S.P.	-
050-8	01102B	3/8" B.S.P.	1.3

FM060

Type	Part No.	Oil Inlet Thread	C.O.V. Rating, bar
060-31	01288A	3/8" B.S.P.	1.3
060-32	01288A	3/4" UNF	1.3
060-33	01210A	M 18 x 1.5	1.3
060-34	01211A	3/8" B.S.P.	-

FM060-LCB

Type	Part No.	Oil Connection	Air Connection	C.O.V. Rating, bar
060-LCB	01171A	1/2" NPTF	1/4" NPTF	-
060-LCB Transat	01172A	1/2" NPTF	1/4" NPTF	1.3

FM200

Type	Part No.	Oil Inlet Thread	C.O.V. Rating, bar	Threaded Fixing Holes
200-21	01197A	1/2" B.S.P.	2.5	M 12
200-22	01198A	7/8" UNF	2.1	1/2" UNC
200-25	01199A	M 22 x 1.5	2.5	M 12
200-28	01200A	M 22 x 1.5	1.5	M 12

FM600

Type	Part No.	Oil Inlet Thread	C.O.V. Rating, bar	Threaded Fixing Holes
600-21	01187A	3/4" B.S.P.	-	M 12
600-22	01188A	3/4" B.S.P.	3.5	M 12
600-23	01189A	3/4" B.S.P.	2.5	M 12
600-24	01190A	1 5/16" UNF	2.5	1/2" UNC
600-25	01192A	3/4" NPT	2.5	1/2" UNC
600-26	01193A	M 27 x 1.5	2.5	M 12

The Environment

Environmental concern for the safe and efficient disposal of all engine waste products is growing worldwide. Legislation in many areas dictates that previously ignored scrap components must now be recycled to save the world's non-replenishable natural resources. Already, disposal of oil filter elements in landfill sites is prohibited in many US states; similar legislation is being introduced in Europe and other areas of the world.

The contaminant removed by the centrifuge passes the US Environmental Protection Agency (EPA) Toxicity Characteristic Leaching Procedure known as TCLP. All MANN+HUMMEL centrifuges are designed to remove contaminant that is almost free from oil and that can be disposed as harmless waste.

Many of the technologies used by engine manufacturers to reduce harmful exhaust emissions increase the level of soot in the lubricating oil. MANN+HUMMEL by-pass centrifuge technology has been proven to have the ability to remove large amounts of harmful combustion soot and therefore allowing the manufacturer to achieve future emission reductions in line with worldwide environmental legislation without compromising service intervals.

MANN+HUMMEL continues to develop its oil conditioning technology to meet both the technical and environmental requirements current and future within the many markets in which we operate.





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